The Mechanics of the Ph.D.

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This narrative reports on original research into the primary variables affecting success or failure of doctoral candidates. It describes a study that found that a previously overlooked variable, condition of one's car, may be a critical factor in doctoral success. Also analyzed in this article (which was submitted by a friend of the researcher) are the stepwise multiple regression procedure utilized and long-term implications of the study.

I have a friend whose name is Phil. He came over the other day and said that he finally did it. After 6 years, he actually finished his doctorate. He told me that it was a lot of hard work taking all those courses, getting his proposal accepted, writing the dissertation, and then going through the last step, the defense. I congratulated him, and to make conversation I asked him what had helped him the most in getting his Ph.D. I offered such suggestions as intelligence, creativity, or rigorous adherence to the scientific method in his research. But he surprised me when he said that the most important thing in getting him through was his car. He went on to tell me that the condition of your car is so important at advanced levels of study that he ended up writing his dissertation on it.

Phil said that after he had taken just a few courses, he started to realize how many tough miles Ph.D candidates have to put on their cars: the wear and tear back and forth to campus in the heat of summer and in the cold of winter — going to class, doing research at the library, meeting with advisors. There is a lot of driving at night, too. He said that it seemed that once students got accepted into a doctoral program they would have a good chance at making it all the way to the commencement ceremony when the degree is actually conferred if they could just keep their cars running.

Phil said that he started doing some preliminary research and found that students with older cars, no matter how smart they were, would eventually drop out. He said the older cars almost always developed mechanical problems that were just too much to overcome and that could lead to physical and psychological problems that would force students out. He said that he didn't realize until later the wisdom of the dean's closing remarks during orientation week: "In closing, just remember one thing, candidates. When the car dies it's all over."

A good example of this was his friend Ron, who Phil said had a very high IQ and had already begun his research when he developed a series of radiator problems. At first Ron started getting to class late. Then, gradually, he started missing first a few then more and more classes. Phil used to see Ron during break at the drinking fountain filling up two empty Prestone jugs so that on the way home he could add water when the radiator started to boil over. For about a month he remembers seeing Ron — Phil said he could spot him way off in the distance — always carrying those two Prestone jugs, one in each hand, with his books wedged in between his arms and his sides. Then one day he didn't see Ron anymore. Before he knew it a week had gone by and still no Ron. When Phil checked with the dean's office, he found that Ron had withdrawn from the doctoral program. Phil said he couldn't believe it. When he asked what had happened, the secretary looked at him with a serious expression and said, "Cooling system." And that was the last he ever saw of Ron.

Even though I had planned on mowing the lawn and then taking the garbage out for pickup on the following morning, I could see that Phil wanted to stay a while and continue telling me about his doctoral dissertation. We had been standing outside in the front yard. I asked him if he wanted to come in and have a beer. He said, "Yeah, that sounds good." So I drew two cold ones and we sat down at the kitchen table. He took a long drink and then went on with his story. He seemed excited as he began telling me how he had formulated his research question and how he used statistical procedures to analyze his data.

"The more I talked to people," Phil said, "the more I realized that I was on to something big. I started checking the records and found that of the doctoral students who were dropping out, almost all of them had older cars. I decided that if I could do a study on it — maybe send out questionnaires to those who had withdrawn and find out what percentage was due to mechanical breakdowns, I could make a real contribution to the literature. I knew that the most important step would be to get the right statistical procedure now that I had an idea of what my research question would be. So I decided to go to the statistics department the next day."

Seeing that Phil's glass was empty, I asked him if he could use a refill. He said that the first beer had gone down really well and that one more would be very nice indeed. While I was pouring the second beer, Phil began to describe what happened next.

"So the next day I went to the statistics office. I noticed that the walls were a dark gray color and there were no pictures or decorations of any kind on them. When I looked down, I saw that the floor was covered with a thick layer of shredded computer output. All the people there wore glasses and looked like they were related. Nobody

looked up when I walked in, so I just stood there and listened to a group of them — who seemed to be talking in tongues. Finally I went up to one of them who was cleaning his glasses with his bow tie and said, 'Good morning.' He looked at me and said, 'You would have to square the sums of the deviations from two or more sources and then divide by the combined degrees of freedom.'

"When I said, 'Excuse me?' he responded, 'If p is greater than point zero five, then use post hoc comparison tests to maintain the Type I error at theta.' "

Phil said that at this point he didn't know what to say, so he said nothing. "Listening to them, I could feel myself starting to get frustrated," he said. "But at the same time I knew that if I was going to go ahead with my study, I'd have to find out what statistical procedure to use. And this was supposed to be the place to get my answer. So with all of them talking in their strange language, I took a deep breath and blurted out all at once, 'CAN SOMEBODY HELP ME WITH A QUESTION ABOUT STATISTICS?!' You could hear a pin drop. I looked up and saw 12 lenses moving in toward me until they had me completely surrounded. The first one said, 'What is your instrumentation going to be?'

"The second one said, 'I doubt the merits of your study.'

"The third one, a woman, asked, 'Do you have a big N?'

"While I was trying to figure out what that meant, a professor who was wearing slightly thinner rimmed glasses than the rest, a string tie, and a cowboy hat, waded over through the computer output and joined us. He seemed to be kind of a father figure for the group. I thought if I could get through to anybody it would be to him. So I told him about my study and the questionnaire part and my plan to use quantitative analysis. But then I said, 'Or I could do an observational study with *qualitative* analysis of the data.'

"When I said the words, *qualitative analysis*, there was a collective gasp. The guy I had been talking to turned completely red but tried to maintain his composure. He came up real close to me and said in a low voice, 'We don't take kindly to talk about that qualitative stuff. There's only one kind of statistics and that's *quantitative*. We don't like your kind around here, stranger. Now git out!' "

Phil said that it was too much for him. Instead of trying to explain himself further, he started walking backwards toward the door with all of them following him, leaving a wide path in the computer output. "With all of them bearing down on me," he said, "I inched my way slowly out the door and then turned and made a run for it, galloping full tilt down the hall to the stairwell and then out the building. A few of them followed, yelling at me in that strange language. I managed to give them the slip by diving into some bushes outside the computer building and laying flat on my stomach without breathing until they passed by. I could hear them talking to each other, their voices trailing off in the distance saying 'F equals R squared over M — divided by parenthesis one minus R squared over N minus M minus one . . .' "

We filled our glasses again. Phil was becoming more animated as he went on. He told me that what he was about to say he hadn't told anyone else. We clinked our glasses and slapped each other a "high five." Then Phil went on.

"So I asked around and found out from other doctoral students that what most of them actually do is hire a grad student on the QT to do their statistics for them. A friend of mine told me to see a guy named Guido who is a foreign student working on his master's degree in statistics. I had him set up a meeting for me with Guido on the following Saturday night. We met at midnight in a drainpipe right outside the computer building. I learned from Guido that it doesn't make much difference what statistical procedure you use as long as it comes out that there is a significant difference between any two things in your study. He said that once you show a significant difference, that it would also help you "get good mileage" in chapter 5 of your dissertation. 'Then you're home free,' he told me, 'and you'll have no trouble at your defense, and you can usually get your thesis published, no sweat.'

"I was glad that I had met Guido and I was feeling better about the study already. I next asked him the big question about how you actually decide on or choose the statistical procedure that you'll use for your research. He said that he always uses the scientific method by random means. When I asked him to explain, he suggested that we move toward the end of the drainpipe where the streetlight shines almost directly overhead so that we would be able to see better. He then took out a dart board with the names of all the statistical procedures written in the circles, starting with mean, median, and mode on the outside, right up to ANOVA, MANCOVA and post hoc procedures toward the middle, with stepwise multiple regression in dead center. Guido handed me a dart and said, 'Go for it!' and shook my hand.

"I picked up the dart, took aim, and fired. Bam! I couldn't believe it. A bull's-eye! Stepwise multiple regression! Guido was all excited too. He congratulated me and said it was probably the best shot he had ever seen, especially given the lighting. He said that now that I had decided on my statistical procedure, if I wanted him to do the work for me that we should meet back here in 1 week and that I should bring my research question and 500 U.S. dollars in small unmarked bills.

"Even though it seemed a little steep, I figured it would be worth it in the long run, especially if it would help me add to the body of scientific research. And Guido explained that what drives the price up for doing private work for doctoral students is what he called the 'risk factor,' because he uses his advisor's personalized code and computer time. He also said that my study looked like it had a lot of potential, especially with the decision to use stepwise multiple regression. We shook hands and said good night. I left with the feeling that my study was starting to take shape and that my dissertation could be a real breakthrough in the existing literature on success and failure in doctoral programs.

"During that week I worked on the research question and also started calling relatives and friends to see if they could help me raise the $500 I needed for Guido. I was surprised to find a lot of family members were unexpectedly out of town and wouldn't be back for more than a week. But I was pleased with the way my research question turned out. I stated it this way: 'To what extent and in what manner is failure to complete the doctoral degree due to Specific Mechanical Breakdown (SMB) and to what extent is it due to other factors, such as IQ, creativity, etc.?' The dependent

variable was Failure to Complete Ph.D and the predictor variables for the multiple regression procedure were as follows:

1. IQ: Creativity, others
2. SMB (specific mechanical breakdown)
   a. Crankcase
   b. Tranie (fluid, clutch, bands)
   c. Cooling system (radiator, thermostat, hoses)
   d. Brakes (pads, drums, calipers)
   e. Driveshaft
   f. Exhaust system (manifold, muffler, Y pipe)
   g. Electrical (starter, generator, solonoid).

"So," Phil went on, "I drove up to campus the following Saturday night and met Guido in the same drainpipe as before. But this time we met at 1 a.m. just to keep the campus security off guard. I gave Guido my research question, which he said he liked, as well as an envelope with mostly 20s, 10s, and a few 5s. Guido gave me a questionnaire and a cover letter that he had prepared for me to send out to a list of doctoral candidates who had withdrawn from the university. We agreed that our next meeting would be after the questionnaire came back and Guido had a chance to run the data through the computer using the multiple regression procedure.

"It took about a month for the questionnaire to be returned, which was perfect because it gave me just enough time to do my review of literature. I was very happy with the rate of return of the questionnaires; it was 93% on the first mailing. Part of our success may have been due to the fact that in the cover letter to each person, instead of asking for their support, we begged for it. I also sent out a self-addressed stamped envelope with each questionnaire as well as a lottery ticket for the 1 million dollar "Big Mama" jackpot. Then, even though it cost a little more, we also included a 10-dollar gift certificate good toward a tow or car repair — at the garage of their choice — which Guido thought up as a nice added touch.

"I called Guido at a phone booth in the student center; he gave me the number after our last meeting. He picked it up on the first ring and told me to send him the data through the mail, and when he had the results of the multiple regression procedure, he'd send them back to me. He said that this would be the best idea instead of meeting in the drainpipe because they were doing some construction in that part of campus. We agreed that he would send the results to me under an assumed name to a P.O. box in another town, which he suggested I set up after our last meeting, because someone had apparently tipped him off about the construction."

Phil said that the results came about 10 days later. "When I picked up the big brown envelope at the P.O. box, I was so excited," he went on, "that I had to hold myself back from tearing it open right then and there. When I got home, I rushed into the house, tore open the envelope, and spread the large computer output sheet on the kitchen table and started looking over the results, some of which were highlighted in yellow ink. It said:

TABLE 1
Results of Stepwise Multiple Regression Procedure

Variable	B	SE B	Beta	T	Significance
Predictor variable for "failure to complete Ph.D" that entered on Step 1					
SMB: Cooling	.395175	.131068	.359995	2.989	.0041[a]
Predictor variables for "failure to complete Ph.D" that entered on Step 2					
SMB: Cooling	.168582	.072020	.281429	2.341	.0225[a]
SMB: Tranie	1.017233	.485717	.251795	2.094	.0314[a]
Predictor variables not in the equation					
IQ					n.s.[b]
Creativity					n.s.
Other					n.s.

a. Highly significant.
b. n.s. = not significant.

I was amazed when Phil started quoting all the numbers and statistics exactly from his study, which he seemed to know by heart. Although I didn't understand everything, it was pretty clear that he had gotten the results he was looking for and that there was a significant correlation between the dropout rate of doctoral students and what he called SMB, "Specific Mechanical Breakdown" — cooling system and transmission problems being the variables that accounted for most of the mechanical breakdowns, whereas other factors such as level of IQ and creativity did not figure in as significant reasons for students' leaving their doctoral programs.

As Phil related his triumphant moment, he was clearly elated. He said, "It was the greatest day of my life when I got those results." We filled our glasses one more time, and I proposed a toast to his success.

I walked Phil to the door. He turned before he left and said, "It was just like Guido told me at our first meeting; my defense was a great success. A lot of the professors there complimented me on the choice of stepwise multiple regression as my statistical procedure. Several of them said they were going to work on a memo to their current doctoral students telling them to have their cooling systems and transmissions completely overhauled. One professor even proposed that the university make it mandatory for students to include the make, model, and year of their car on the application for admission form to all doctoral programs."

After that I didn't see Phil for a while. But one day when I was in the library I came across a scientific journal called *New England Research Monthly*. It publishes research by the finest minds all over the country and the world. I opened it up and on the first page — I couldn't believe it — there was a picture of Phil! Next to him in boldface letters it said, "Getting Tuned up for the Dissertation: The Effects of Specific Mechanical Breakdown (SMB) on Doctoral Dropouts." Underneath that, there was a foreword written by Guido.

Incredible! I tried to get hold of Phil to talk to him about it, but he never seemed to be home. I figured that he must be pretty busy and would probably give me a call when he got a chance. Sure enough, one evening a month or so later, the phone rang. It was Phil calling from Denver. He said his life had changed completely since his SMB article was published.

"Things happened so fast," he said. "I started getting calls and letters from professors, admissions officers, counselors — even college presidents — from all over the country asking me to speak to them about my findings on Specific Mechanical Breakdown. In addition to its applicability to doctoral students, one question that kept coming up was whether my SMB research would also apply to master's degree candidates and undergraduates."

Because of this recurring question, Phil said he contacted Guido and asked him to come up with an instrument to identify graduate and undergraduate students who would be at greatest risk for dropping out of college due to Specific Mechanical Breakdown. Guido got right on it and developed something he called the SMB Inventory, which can be used with students age 18 and up. It is a rating scale on which the student self-reports personal data, then gives the make, model, and year of his or her car and provides verifiable maintenance check dates with special attention to oil changes, transmission inspection, and radiator flushes. Then Guido feeds all the data into a computer and comes up with a standard score that will place the student at low risk, moderate risk, or high risk for Specific Mechanical Breakdown. Then, through appropriate automotive counseling, the number of students who drop out can be reduced.

Phil said that right now the SMB Inventory is really in demand. Besides giving talks and workshops, he also gives training sessions on how to administer and interpret the inventory. He seemed surprised by how busy he has been and how lucrative his speaking tour and his training sessions have become.

"I had so many requests to speak," he said, "that I couldn't handle it myself. So I got an agent who specializes in something called 'Trendy Topics in Education.' He sets up my appearances, mails out preconference biographies and promos, and collects my fees in advance. As part of the package, he even came up with a small dysfunctional plastic engine that we give to each conference participant and that I also autograph free of charge after the conference." Phil said that the dysfunctional engine turned out to be an important part of his presentations because it serves as a powerful symbol of what SMB is all about. In addition, he said, it provides conference participants with a handsome souvenir that they can take back to their respective colleges and universities.

Phil told me that after he leaves Denver, he presents in LA, San Francisco, and Seattle; then Chicago, St. Louis, and Miami; then up to New York City, and finally Boston. After that, he plans on settling down back at his old university where he accepted a high-paying position in the Social Sciences Department, complete with research facilities and carte blanche for whatever he needs, including his own expense account.

"I think I found my niche," Phil said, "I'm continuing my research but will also be able to spend time in the classroom teaching the principles of SMB. I have two courses

that are open to students working on their doctorates in the social sciences. The course titles are Automotive Awareness Training 1 and Automotive Awareness Training 2. The courses are aimed primarily at reducing the number of dropouts from doctoral programs by heightening awareness that Specific Mechanical Breakdown can occur at any time."

Phil said he relies heavily on multisensory and experiental techniques to focus on things that could go wrong mechanically. When I asked him how he does this, he said, "There are about 15 to 20 students in each class whom I have sit around in a circle. I usually start by leading the group in an exetcise called Automotive Guided Imagery, in which students close their eyes and are encouraged to visualize faulty or failing engine parts. For example, the group might visualize a water hose with a leak in it and the radiator boiling over. Another example is encouraging each member to hold on to an imaginary steering wheel that is shaking and vibrating badly due to poor front end alignment."

In addition, Phil said students at advanced levels of Automotive Awareness Training are also encouraged to talk about and work through their own personal episodes of mechanical breakdown by reexperiencing them — in the present — with other group members.

I was glad to hear that Phil was doing well. His Specific Mechanical Breakdown research, the SMB Inventory, and his Automotive Awareness Training classes at the university seem to be making a real difference in his goal of keeping doctoral, master's, and undergraduate students from dropping out of college. I know, too, that he must be doing well financially. I asked him what he plans to do with all the money he has made so far — buy a new house, buy a yacht, invest in the stock market.

"Actually," he said, "there *is* something I've been thinking about for quite a while."

"What is that?" I asked.

"A tune-up, oil change, and lube," he said.